AMENDMENTS TO THE SPECIFICATION

Please replace the present title with the following amended title:

Method, Device, and Computer Program for Video Image Processing

Please amend the paragraph beginning on line 25 of pg. 10 as follows:

The expression "acquiring a plurality of second interpolated frames which are correlated with the plurality of first interpolated frames" is intended to mean acquiring a number of second interpolated frames corresponding to the number of first interpolated frames. That is, a pixel value within a reference patch is interpolated so that it is assigned at the same pixel position as a pixel position in a first interpolated frame that has a pixel value, whereby a second interpolated frame corresponding to that first interpolated frame is acquired. ~~And this~~This processing is performed on all of the first interpolated frames.

Please amend the paragraph beginning on line 7 of pg. 13 as follows:

Moreover, the coordinate-transformed frame is acquired by transforming the coordinates of the image within the second patch of the other frame to a coordinate space of the reference frame, based on the correspondent relationship. ~~And the~~The correlation value is computed and represents a correlation between the image within the patch of the coordinate-transformed frame and the image within the reference patch of the reference frame. The weighting coefficient, which is employed when synthesizing the first interpolated frame and the second interpolated frame, is computed based on the correlation value. As the correlation between the coordinate-transformed frame and the reference frame becomes greater, the weighting coefficient makes the weight of the first interpolated frame greater. In the case where three or more frames are

sampled, the coordinate-transformed frame, correlation value, and weighting coefficient are acquired for each of the frames other than the reference frame.

Please amend the paragraph beginning on line 17 of pg. 26 as follows:

The expression "acquiring a plurality of second interpolated frames which are correlated with the plurality of first interpolated frames" is intended to mean acquiring a number of second interpolated frames corresponding to the number of first interpolated frames. That is, a pixel value within a reference patch is interpolated so that it is assigned at the same pixel position as a pixel position in a first interpolated frame that has a pixel value, whereby a second interpolated frame corresponding to that first interpolated frame is acquired. ~~And this~~This processing is performed on all of the first interpolated frames.

Please amend the paragraph beginning on line 2 of pg. 38 as follows:

In a preferred form of the fifth synthesis method of the present invention, the aforementioned correspondent relationships are acquired in order of the other frames closer to the reference frame, and a correlation is acquired between each of the other frames, in which the correspondent relationship is acquired, and the reference frame. ~~And when~~When the correlation is lower than a predetermined threshold value, acquisition of the correspondent relationships is stopped, and the synthesized frame is obtained based on the correspondent relationship by employing the other frames, in which the correspondent relationship has been acquired, and the reference frame.

Please amend the paragraph beginning on line 1 of pg. 40 as follows:

In a preferred form of the fifth video image synthesizer of the present invention, the correspondent relationship acquisition means acquires the correspondent relationships in order of other frames closer to the reference frame. Also, the fifth video image synthesizer further comprises stoppage means for acquiring a correlation between each of the other frames, in which the correspondent relationship is acquired by the correspondent relationship acquisition means, and the reference frame, and stopping a process which is being performed in the correspondent relationship acquisition means when the correlation is lower than a predetermined threshold value. ~~And the~~The frame synthesis means acquires the synthesized frame by employing the other frames, in which the correspondent relationship has been acquired, and the reference frame, based on the correspondent relationship acquired by the correspondent relationship acquisition means.

Please amend the paragraph beginning on line 21 of pg. 45 as follows:

In another preferred form of the sixth video image synthesizer of the present invention, the aforementioned correlation computation means computes a histogram for at least one of the Y, Cb, and Cr components of each of the adjacent frames (where the Y component is a luminance component and the Cb and Cr components are color difference components), also computes a Euclidean distance for each component between the adjacent frames by employing the histogram, and computes the sum of the Euclidean distances for the three components. ~~And when~~When the sum is a predetermined second threshold value or greater, the aforementioned contiguous frame group detection means judges that the correlation between the adjacent frames is lower than the predetermined first threshold value.

Please amend the paragraph beginning on line 13 of pg. 46 as follows:

In the sixth video image synthesizer of the present invention, the aforementioned correlation computation means may compute a difference between pixel values of corresponding pixels of the adjacent frames and also compute the sum of absolute values of the differences for all corresponding pixels. ~~And when~~When the sum is a third threshold value or greater, the contiguous frame group detection means may judge that the correlation between adjacent frames is lower than the predetermined first threshold value.

Please amend the paragraph beginning on line 19 of pg. 50 as follows:

In the seventh and eighth synthesis methods of the present invention, when extracting the aforementioned important scenes, a correlation between adjacent frames of the video image is computed. ~~And a~~ A set of contiguous frames where the correlation is high can be extracted as the frame group that constitutes one or more important scenes.

Please amend the paragraph beginning on line 7 of pg. 71 as follows:

Further, a lattice point in the patch P1 is moved in the 4 directions along the coordinate axes by constant pixel quantities. When this occurs, a rectangular area containing the moved lattice point is deformed as shown in Fig. 3, for example. ~~And correlation~~ Correlation values between the deformed rectangular area and the corresponding rectangular area of the reference patch P0 are computed. These correlation values are assumed to be $E1(\Delta x, 0)$, $E1(-\Delta x, 0)$, $E1(0, \Delta y)$, and $E1(0, -\Delta y)$.

Please amend the paragraph beginning on line 26 of pg. 72 as follows:

Now, consider how a point (x, y) within the patch P1 (xn, yn) corresponds to a point (x', y') within the reference patch P0 (x'n, y'n), as illustrated in Fig. 4. First, a point (x, y) within the patch P1 (xn, yn) is transformed to normalized coordinates (u, v), which are computed by inverse transformation of Formulas 5 and 6. ~~And based~~Based on the reference patch P0 (x'n, y'n) corresponding to the normalized coordinates (u, v), coordinates (x', y') corresponding to the point (x, y) are computed by Formulas 5 and 6. The coordinates of a point (x, y) are integer coordinates where pixel values are originally present, but there are cases where the coordinates of a point (x', y') become real coordinates where no pixel value is present. Therefore, pixel values at integer coordinates after transformation are computed as the sum of the weighted pixel values of coordinates (x', y'), transformed within an area that is surrounded by 8 neighboring integer coordinates adjacent to integer coordinates in the reference patch P0.

Please amend the paragraph beginning on line 7 of pg. 78 as follows:

~~And by~~By assigning a pixel value in the succeeding frame FrN+1 to all integer coordinates of a synthesized image, a pixel value I1N+1(x ^ , y ^) can be obtained. In this case, each pixel value I1(x ^ , y ^) in the first interpolated frame FrH1 becomes I1N+1(x ^ , y ^).

Please amend the paragraph beginning on line 8 of pg. 84 as follows:

While the process of acquiring the synthesized frame FrG for the luminance component Y has been described, synthesized frames FrG for color difference components Cb and Cr are acquired in the same manner. ~~And by~~By combining a synthesized frame FrG(Y) obtained from the luminance component Y and synthesized frames FrG(Cb) and FrG(Cr) obtained from the color difference components Cb and Cr, a final synthesized frame is obtained. To expedite

processing, it is preferable to estimate a correspondent relationship between the reference frame FrN and the succeeding frame FrN+1 only for the luminance component Y, and process the color difference components Cb and Cr on the basis of the correspondent relationship estimated for the luminance component Y.

Please amend the paragraph beginning on line 22 of pg. 85 as follows:

~~And based~~Based on the correspondent relationship estimated by the correspondent relationship estimation means 2, the coordinates of the succeeding frame FrN+1 are transformed to the coordinate space in the reference frame FrN by the coordinate transformation means 3, whereby a coordinate-transformed frame FrT0 is acquired (step S4). ~~And the~~The correlation value d0(x, y) of corresponding pixels of the coordinate-transformed frame FrT0 and reference frame FrN is computed by the correlation-value computation means 6 (step S5). Further, the weight computation means 7 computes a weighting coefficient $\alpha(x^\circ, y^\circ)$, based on the correlation value d0(x, y) (step S6).

Please amend the paragraph beginning on line 16 of pg. 86 as follows:

~~And in~~In the synthesis means 8, a pixel value $I1(x^\circ, y^\circ)$ in the first interpolated frame FrH1 and a pixel value $I2(x^\circ, y^\circ)$ in the second interpolated frame FrH2 are synthesized, whereby a synthesized frame FrG consisting of a pixel value $FrG(\hat{x}, \hat{y})$ is acquired (step S9), and the processing ends.

Please amend the paragraph beginning on line 25 of pg. 88 as follows:

~~And in~~In the second embodiment, with weight computation means 7 a weighting coefficient $\alpha(x^\circ, y^\circ)$ is acquired based on the correlation value d0'(x, y) filtered by the filter

means 9, and the weighting coefficient $\alpha(x^{\circ}, y^{\circ})$ is employed in the weighting and addition operations that are performed in the synthesis means 8.

Please amend the paragraph beginning on line 21 of pg. 91 as follows:

~~And by~~By performing a weighting operation on corresponding first and second interpolated frames Fr_{H1t} and Fr_{H2t} by the weighting coefficient $\alpha t(x^{\circ}, y^{\circ})$ and also adding the weighted frames, an intermediate synthesized frame Fr_{Gt} with a pixel value $Fr_{Gt}(x^{\wedge}, y^{\wedge})$ at integer coordinates in a synthesized image is acquired. More specifically, as shown in the following Formula 19, the pixel values $I_{1t}(x^{\circ}, y^{\circ})$ and $I_{2t}(x^{\circ}, y^{\circ})$ of corresponding pixels of the first and second interpolated frames Fr_{H1t} and Fr_{H2t} are weighted by employing the corresponding weighting coefficient $\alpha t(x^{\circ}, y^{\circ})$, and the weighted values are added. In this manner, the pixel value $Fr_{Gt}(x^{\wedge}, y^{\wedge})$ of an intermediate synthesized frame Fr_{Gt} is acquired.

Please amend the paragraph beginning on line 17 of pg. 92 as follows:

~~And by~~By adding the intermediate synthesized frames Fr_{Gt}, a synthesized frame Fr_G is acquired. More specifically, by adding corresponding pixels of intermediate synthesized frames Fr_{Gt} with the following Formula 20, a pixel value $Fr_G(x^{\wedge}, y^{\wedge})$ in a synthesized frame Fr_G is acquired.

Please amend the paragraph beginning on line 6 of pg. 93 as follows:

In the case of acquiring a synthesized frame FrG from three or more frames, first and second interpolated frames FrH1t and FrH2t with pixel values at the integer coordinates of a

synthesized image, and a weighting coefficient αt(x ˆ , y ˆ) at the integer coordinates, may be acquired. In this case, for each frame FrN+t (0 ≦ t ≦ T-1), pixel values I1N+t(x , y) in each frame FrN+t are assigned to all integer coordinates of synthesized coordinates, and a first interpolated frame FrH1t with pixel values I1N+t(x ˆ , y ˆ) (i.e., I1t(x ˆ , y ˆ)) is acquired. ~~And by~~By adding the pixel values I1t(x ˆ , y ˆ) assigned to all frames FrN+t and the pixel values I2t(x ˆ , y ˆ) of the second interpolated frame FrH2t, a plurality of intermediate synthesized frames FrGt are obtained, and they are combined into a synthesized frame FrG.

Please amend the paragraph beginning on line 19 of pg. 93 as follows:

More specifically, as shown in the following Formula 21, a pixel value I1N+t(x ˆ , y ˆ) at integer coordinates in a synthesized image is computed for all frames FrN+t. ~~And as~~As shown in Formula 22, an intermediate synthesized frame FrGt is obtained by weighting pixel values I1t(x ˆ , y ˆ) and I2t(x ˆ , y ˆ), employing a weighting coefficient α(x ˆ , y ˆ). Further, as shown in Formula 20, a synthesized frame FrG is acquired by adding the intermediate synthesized frames FrGt.

Please amend the paragraph beginning on line 9 of pg. 97 as follows:

~~And in~~In synthesis means 8, a pixel value $I_1(x°, y°)$ in the first interpolated frame Fr_{H1} and a pixel value $I_2(x°, y°)$ in the second interpolated frame Fr_{H2} are synthesized, whereby a synthesized frame Fr_G consisting of a pixel value $Fr_G(x^\wedge, y^\wedge)$ is acquired (step S18), and the processing ends.

Please amend the paragraph beginning on line 15 of pg. 106 as follows:

~~And in~~In the synthesis means 8, a pixel value $I_1(x°, y°)$ in the first interpolated frame Fr_{H1} and a pixel value $I_2(x°, y°)$ in the second interpolated frame Fr_{H2} are synthesized, whereby a synthesized frame Fr_G consisting of a pixel value $Fr_G(x^\wedge, y^\wedge)$ is acquired (step S60), and the processing ends.

Please amend the paragraph beginning on line 24 of pg. 111 as follows:

Fig. 24 shows processes that are performed in the fifth embodiment. As with the fourth embodiment, consider the case where a first interpolated frame FrH1, a second interpolated frame FrH2, and a weighting coefficient $\alpha(x^{\circ}, y^{\circ})$ are acquired at real coordinates to which pixels of the frame FrN+1 in a synthesized image are assigned. In the video image synthesizer of the fifth embodiment, as shown in Fig. 24, video image data M0 is first input (step S62). To acquire a synthesized frame from the video image data M0, the reduction means 42 of the sampling means 11A performs a reduction process on the video image data M0 and obtains reduced video image data (step S64). The sampling execution means 48 sets a sampling range on the basis of a correlation between each reduction frame and a reduction reference frame acquired by the correlation acquisition means 44, and samples frames from the video image data M0 in a range corresponding to the sampling range. The sampling range is from the reduction reference frame to a reduction frame, which is closer to the reduction reference frame, between a pair of adjacent reduction frames whose correlation is lower than a predetermined threshold value. On the other hand, when the processing in the correlation acquisition means 44 is stopped by the stoppage means 46, the sampling execution means 48 sets a sampling range from a

reduction reference frame to a reduction frame being processed at the time of the stoppage, and samples frames from the video image data M0 in a range corresponding to the sampling range. The S frames sampled by the sampling execution means 48 are output to the correspondent relationship acquisition means 12 (step S66). The correspondent relationship acquisition means 12 places a reference patch on the reference frame FrN (step S68), also places the same patch as the reference patch on the succeeding frame FrN+1, and moves and/or deforms the patch until a correlation value E between an image within the reference patch and an image within the patch of the succeeding frame FrN+1 converges (steps S72 and S74). ~~And the~~<u>The</u> correspondent relationship acquisition means 12 acquires a correspondent relationship between the reference frame FrN and the succeeding frame FrN+1 (step S78). The correspondent relationship acquisition means 12 performs the processes in steps S72 to S78 on all frames excluding the reference frame ("YES" in step S80, step S85).

Please amend the paragraph beginning on line 5 of pg. 129 as follows:

Thus, in the eighth embodiment, with respect to frames Fr2 and Fr3 temporally before and after frame Fr1, similarities b2 and b3 with frame Frl are computed, and if similarities b2 and b3 are great, contributory degrees (weighting coefficients) β2 and β3 are made greater. ~~And frames~~<u>Frames</u> Fr2 and Fr3 are weighted and added to frame Fr1, whereby a processed frame FrG is obtained. Because of this, there is no possibility that a frame not similar to frame Fr1, as it is, will be added to frame Fr1. This renders it possible to add frames Fr2 and Fr3 to frame Frl while reducing the influence of dissimilar frames. Consequently, a processed frame FrG with

high quality can be obtained while reducing blurring that is caused by synthesis of frames whose similarity is low.

Please amend the paragraph beginning on line 7 of pg. 132 as follows:

Now, a description will be given of operation of the ninth embodiment. Fig. 38 shows processes that are performed in the ninth embodiment. First, the sampling means 101 samples frames Fr1, Fr2, and Fr3 from video image data M0 (step S141). Then, in the similarity computation means 112, similarities b2(m, n) and b3(m, n) between area A1(m, n) in frame Fr1 and corresponding areas A2(m, n) and A3(m, n) are computed (step S142). Next, in the contributory degree computation means 113, contributory degrees β2(m, n) and β3(m, n) are computed by multiplying similarities b2(m, n) and b3(m, n) by a reference contributory degree k (step S143). ~~And in~~In accordance with contributory degrees β2(m, n) and β3(m, n), corresponding areas A2(m, n) and A3(m, n) are weighted and added to area A1(m, n), whereby a processed frame FrG is obtained (step S144) and the processing ends.

Please amend the paragraph beginning on line 21 of pg. 132 as follows:

Thus, in the ninth embodiment, frame Fr1 is partitioned into a plurality of areas A1(m, n), and similarities b2(m, n) and b3(m, n) are computed for area A2(m, n) and area A3(m, n) in frames Fr2 and Fr3 which correspond to area A1(m, n). ~~And if~~If similarities b2(m, n) and b3(m, n) are great, contributory degrees (weighting coefficients) β2(m, n) and β3(m, n) are made greater. ~~And corresponding~~Corresponding areas A2(m, n) and area A3(m, n) are weighted and added to area A1(m,n), whereby a processed frame FrG is obtained. Because of this, even when

a certain area in a video image is moved, blurring can be removed for each area moved. As a result, a processed frame FrG with high quality can be obtained.

Please amend the paragraph beginning on line 6 of pg. 135 as follows:

As illustrated in Fig. 40, the motion-vector computation means 105 partitions frame Fr1 into m × n block-shaped areas A1(m, n) and moves each of the areas A(m, n) in parallel with frame Fr1. ~~And when~~When a correlation between pixel values in area A1(m, n) and frame Fr2 is highest, the moved quantity and moving direction of area A1(m, n) is computed as motion vector V0(m, n) for that area A1(m, n). Note that when the accumulation of the squares of differences between pixel values of area A1(m, n) and frame Fr2 or accumulation of absolute values is smallest, the correlation is judged to be highest.

Please amend the paragraph beginning on line 4 of pg. 138 as follows:

Next, in the similarity computation means 122, similarities b2(O1) and b2(O2) between subject areas O1, O2 in frame Fr1 and corresponding subject areas O1(Fr2) and O2(Fr2) in frame Fr2 are computed and similarities b3(O1) and b3(O2) between subject areas O1, O2 in frame Fr1 and corresponding areas O1(Fr3) and O2(Fr3) in frame Fr3 are computed (step S155). Next, in the contributory degree computation means 123, contributory degrees β2(O1),β2(O2), β3(O1), and β3(O2) are computed by multiplying similarities b2(O1), b2(O2) and b3(O1), and b3(O2) by a reference contributory degree k (step S156). ~~And in~~In accordance with contributory degrees β2(O1) and β2(O2) and contributory degrees β3(O1) and β3(O2), the corresponding subject areas O1(Fr2) and O2(Fr2) and corresponding subject areas O1(Fr3) and O2(Fr3) are weighted and

added to the subject areas O1 and O2, respectively. In this manner, a processed frame FrG is obtained (step S157) and the processing ends.

Please amend the paragraph beginning on line 20 of pg. 138 as follows:

Thus, in the tenth embodiment, frame Fr1 is partitioned into a plurality of subject areas O1 and O2, and similarities b2(O1) and b2(O2) and similarities b3(O1) and b3(O2) are computed for the subject areas O1(Fr2) and O2(Fr2) and subject areas O1(Fr3) and O2(Fr3) in frames Fr2 and Fr3 which correspond to the subject areas O1 and O2. ~~And if~~If similarities b2(O1) and b2(O2) and similarities b3(O1) and b3(O2) are great, contributory degrees (weighting coefficients) $\beta 2(O1)$, $\beta 2(O2)$, $\beta 3(O1)$, $\beta 3(O2)$ are made greater. ~~And the~~The corresponding subject areas O1(Fr2) and O2(Fr2) and corresponding subject areas O1(Fr3) and O2(Fr3) are weighted and added to the subject areas O1 and O2, whereby a processed frame FrG is obtained. Because of this, even when a certain subject area in a video image is moved, blurring can be removed for the subject area moved. As a result, a processed frame FrG with higher quality can be obtained.